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A DIS Entity State PDU Generator

Lucien Zalcman

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ABSTRACT

The recent I/ITSEC 2001 Coalition Training Demonstration held between the US, Australian and Dutch Navies demonstrated a coalition training exercise using Advanced Distributed Simulation to simultaneously connect military training simulators in the USA, Australia and the Netherlands. Whilst participating in the setup and running of this exercise each nation used whatever tools were available to establish and maintain connectivity and interoperability. As one of the lessons learned from such a coalition exercise, this paper discusses a proposal to make available to all participating coalition nations a Common Coalition Toolset (CCT) which comprises a set of software applications used to establish and maintain connectivity and interoperability for such coalition training demonstrations and/or exercises. This paper describes a candidate CCT application - a DIS Entity State PDU Generator. This application was found to be extremely useful when setting up a multiplayer Advanced Distributed Simulation such as the recent I/ITSEC 2001 Coalition Training Demonstration.

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Executive Summary

In December, 2001 a valid Coalition Training Exercise was held between RAN training simulators at HMAS Watson in Sydney, US Navy simulators at Dam Neck, Virginia and the I/ITSEC 2001 conference in Orlando, Florida and simulators at the TNO Laboratories in the Netherlands using Advanced Distributed Simulation.

Whilst participating in the setup and running of this exercise each participating nation used whatever tools were available to establish and maintain connectivity and interoperability. As one of the lessons learned from such a coalition exercise, this report discusses a proposal to make available to all participating coalition nations a Common Coalition Toolset (CCT) which comprises a set of software applications used to establish and maintain connectivity and interoperability for such coalition training demonstrations and/or exercises. This paper describes a candidate CCT application - a DIS Entity State PDU Generator. This application was found to be extremely useful when setting up a multiplayer Advanced Distributed Simulation such as the recent I/ITSEC 2001 Coalition Training Demonstration.

Having such a Common Coalition Toolset, which all participating nations have access to, allows such demonstrations and exercises to be more effectively and efficiently set up, maintained and monitored.

It is proposed that the DIS Entity State PDU Generator be a component of a Common Coalition Toolset, which will be distributed to nations participating in future coalition exercises, under the recently signed PMS430 Project Arrangement between the United States Navy and DSTO.

Authors

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Dr Lucien Zalcman graduated from Melbourne University with a BSc (Hons.) in 1973. He was awarded a PhD in Physics from Melbourne University in 1980. He also completed a Graduate Diploma in Computing Studies at RMIT graduating in 1987. During the period 1980 - 1984 he worked as an Experimental Officer at the CSIRO Division of Mineral Chemistry carrying out research into lead acid batteries for electric vehicles. He joined DSTO in 1984 as an Information Technology Officer in the Computer Centre at the Aeronautical Research Laboratory. In 1992 he was employed as a Senior Professional Officer in Air Operations Division of AMRL specialising in the field of Distributed Interactive Simulation. He was promoted to Senior Research Scientist in 1998.

Contents

Glossary of Acronyms

ADF	Australian Defence Force
ADS	Advanced Distributed Simulation
AOD	Air Operations Division
COTS	Commercial-Off-The-Shelf
DDG	Guided Missile Destroyer
DIS	Distributed Interactive Simulation
DoD	US Department of Defense
DSTO	Defence Science & Technology Organisation
FFG	Guided Missile Frigate
HLA	High Level Architecture
IEEE	Institute of Electrical and Electronic Engineers
IST	Institute of Simulation and Training (US)
LAN	Local Area Network
PDU	Protocol Data Unit
RAAF	Royal Australian Air Force
SMOC	Simulation Middleware Object Classes
STRICOM	Simulation Training and Instrumentation COMmand (US Army)
USN	United States Navy
WAN	Wide Area Network

1. Introduction

The Australian Defence Force (ADF) is adopting Advanced Distributed Simulation (ADS) technologies such as Distributed Interactive Simulation (DIS) and High Level Architecture (HLA) to enhance its training capability. To support this thrust, Air Operations Division (AOD) of the Defence Science and Technology Organisation (DSTO) has developed the Advanced Distributed Simulation Laboratory (ADSL) which promotes the use of modular, cost-effective, Commercial-Off-the-Shelf (COTS) ADS applications running on low cost computing platforms. The use of COTS software and hardware should lower purchase, development and maintenance costs and increase the probability that project functionality is delivered on time. It is a risk reduction strategy.

On behalf of the Australian Navy, DSTO recently signed a Project Arrangement (PA) with the US Navy (PMS 430 [1]) to advance coalition training using Advanced Distributed Simulation. As part of this Project Arrangement, DSTO and the Australian Navy participated in an Interservice / Industry Training Simulation & Education Conference (I/ITSEC) 2001 Coalition Training Demonstration held between the US, Australian and Dutch Navies which comprised a coalition training exercise using Advanced Distributed Simulation to simultaneously connect military training simulators in the USA, Australia and the Netherlands. Whilst participating in the setup and running of this coalition training exercise, each participating nation used whatever tools were available to establish and maintain connectivity and interoperability. As one of the lessons learned from such an exercise, a previous paper put forward a proposal to develop a Common Coalition Toolset (CCT) [2] which comprises a set of software recommendations and applications that can be used to establish and maintain connectivity and interoperability for such coalition training demonstrations and/or exercises. Applications developed and used in the AOD ADSL [3, 4] (which were used to establish and maintain connectivity and interoperability at the Australian end of the I/ITSEC 2001 demonstration) form the basis of the Australian contribution to the Common Coalition Toolset proposed in this paper.

This paper describes a first candidate CCT application - a DIS Entity State PDU Generator. The functionality available in this application was found to be extremely useful when setting up a multiplayer Advanced Distributed Simulation such as the recent I/ITSEC 2001 Coalition Training Demonstration.

2. CCT Applications

Every Microsoft Windows PC in the AOD ADSL runs the ADSL Management and Configuration (ManCon) application shown in Figure 1 below. The functionality of the ADSL ManCon application has been described in detail in previous publications [3, 4].

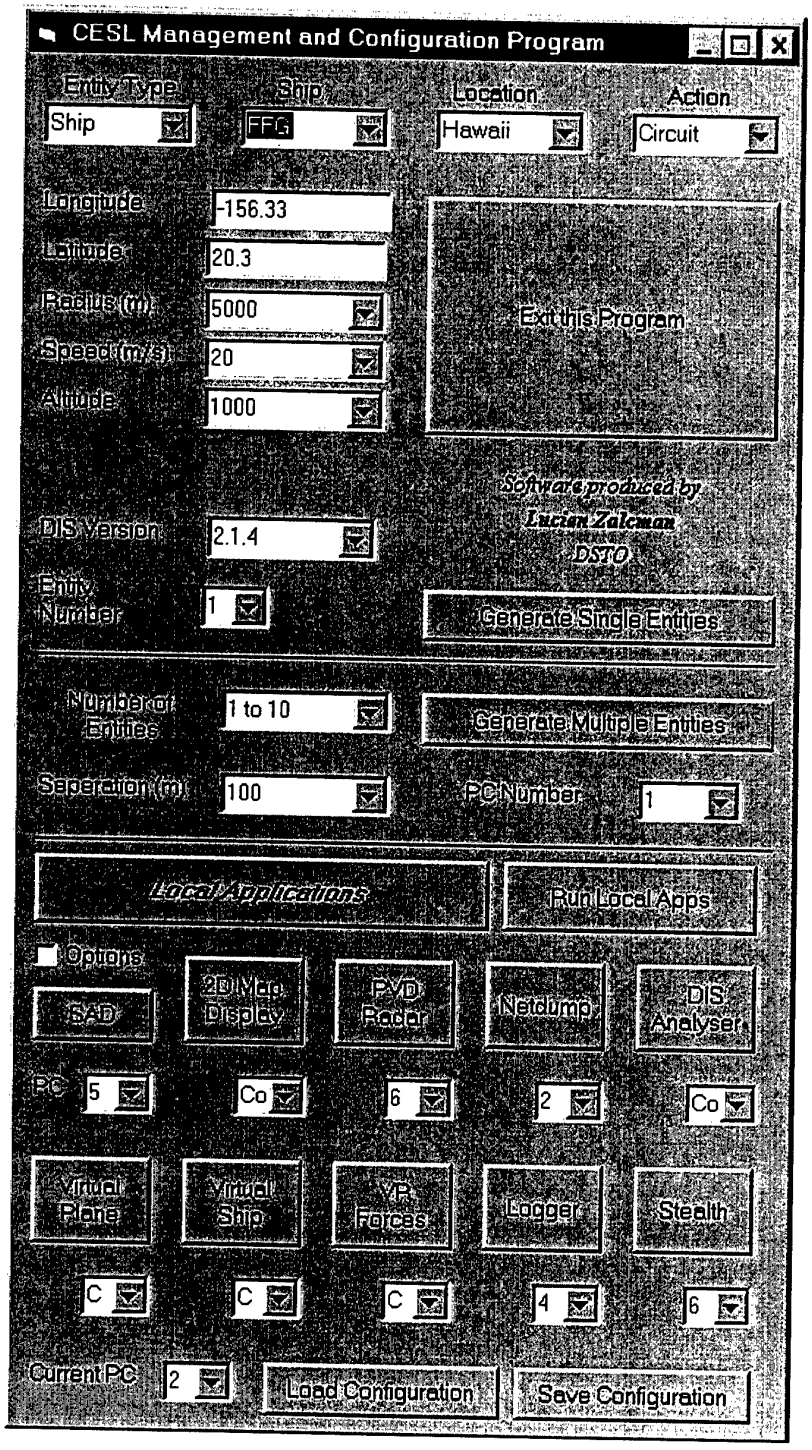

Figure 1: The ADSL ManCon Program.

Any computer on the ADSL network running the ManCon application can run any of the applications supported by ManCon. The same interface is presented to the user and any application can be run from any PC on the network within application licensing restrictions. When the user left clicks the appropriate button from the GUI, ManCon runs a batch file to launch the required application.

Currently, to reduce application load time, all applications and their relevant data files are stored on every PC in the ADSL network. Whenever ManCon itself, or any ManCon loaded application, is modified the modified application must be copied to and updated on every PC on the network. In future, to reduce maintenance, all ADSL applications, including the ManCon application itself, and any corresponding data files will be stored and loaded from an ADSL application file server once the complete ADSL Local Area Network (LAN) is upgraded to 1Gbps networking capability.

The ManCon application is written in Microsoft Visual Basic version 6. Although not applicable to the ADSL ManCon application some Advanced Distributed Simulation applications written in Microsoft Visual Basic version 6 cannot be easily deployed onto PCs which do not have the Visual Basic version 6 compiler installed. When such an application uses the Microsoft Winsock ActiveX component to capture UDP DIS PDU's (Protocol Data Unit) all the required Visual Basic version 6 compiler Service Packs (up to and including Service Pack 6) must also be installed. This makes deployment of such applications difficult and resource intensive.

In the ADSL the ManCon application carries out, through its easy to use GUI, three main functions:

- It provides required Entity State PDUs to test both simulators and networking devices on a Distributed Simulation network;
- It can saturate the Distributed Simulation network to locate any bottlenecks or problem simulators; and
- It is used as an application loader on all the PCs in the ADSL network.

Initially, for a Common Coalition Toolset, the application loader functionality, available in the ADSL ManCon application, is not required.

Early in 2002, Microsoft released newly architected versions of their computer language compilers known as .NET (version 7) compilers [5]. All .NET compilers now access functionality through a common set of class libraries called the .NET Framework. Although the previously mentioned ActiveX Winsock Component was available to both C++ and Visual Basic (version 6) programmers, C++ programmers would have had access to much better (and more) software (eg Winsock libraries) than the Visual Basic programmers and a version 6 C++ programmer would not have used the Winsock ActiveX component. With the release of the .NET compilers, all .NET programmers have access to the same capabilities from all languages through the .NET Framework classes. This reduces considerably the likelihood of bugs such as the

ActiveX Winsock component (Signal PDU) size bug that was probably never reported because the Winsock ActiveX component was possibly only used by a very small number of Visual Basic (version 6) programmers. Any such errors in the .NET Frameworks Sockets classes would have been quickly reported by all the C++.NET programmers using these classes which a Visual Basic.NET programmer would now also use. Thus .NET (eg version 7) compilers would be considerably more "bug free" than their equivalent language version 6 compilers. For this reason, it was decided to split the functionality of the ADSL ManCon application and rewrite the application(s) using the new .NET compilers.

For a Common Coalition Toolset the main lessons learned from the ADSL ManCon application are:

- The same interface / application should be used by all users;
- To reduce maintenance the applications should able to be run (and maintained) from a file server when used in a network environment;
- CCT applications must be reliably and easily deployable; and
- To increase reliability the ManCon application(s) should be rewritten using the newly released .NET compilers.

3. A Common Coalition Toolset DIS Entity State PDU Generator

To test an ADS network, an Entity Generator, which injects Entity State PDUs (ESPDUs) or HLA packets onto the ADS network, is required. Other ADS applications on the network are then tested to see if they interoperate correctly with these generated ESPDUs.

In the ADSL, the Visual Basic ManCon Application generates entities by executing the MäK Technologies [6] VR-Link f18 utility program with the appropriate command line parameters (entity type and enumeration, longitude, latitude, circuit radius, speed, altitude, DIS version number etc.). For the CCT, the f18 utility could be replaced by a functionally equivalent, royalty free, application, produced using the USN developed Simulation Middleware Object Classes (SMOC) toolkit. Additional command line parameters, such as a user input markings field, could also be added.

The Entity Generator application quickly and easily tests whether the computer running the application can successfully inject entities onto the ADS network.

The (CCT) ADSL Entity Generator has been rewritten using Microsoft's Visual Basic.NET and is shown in Figure 2.

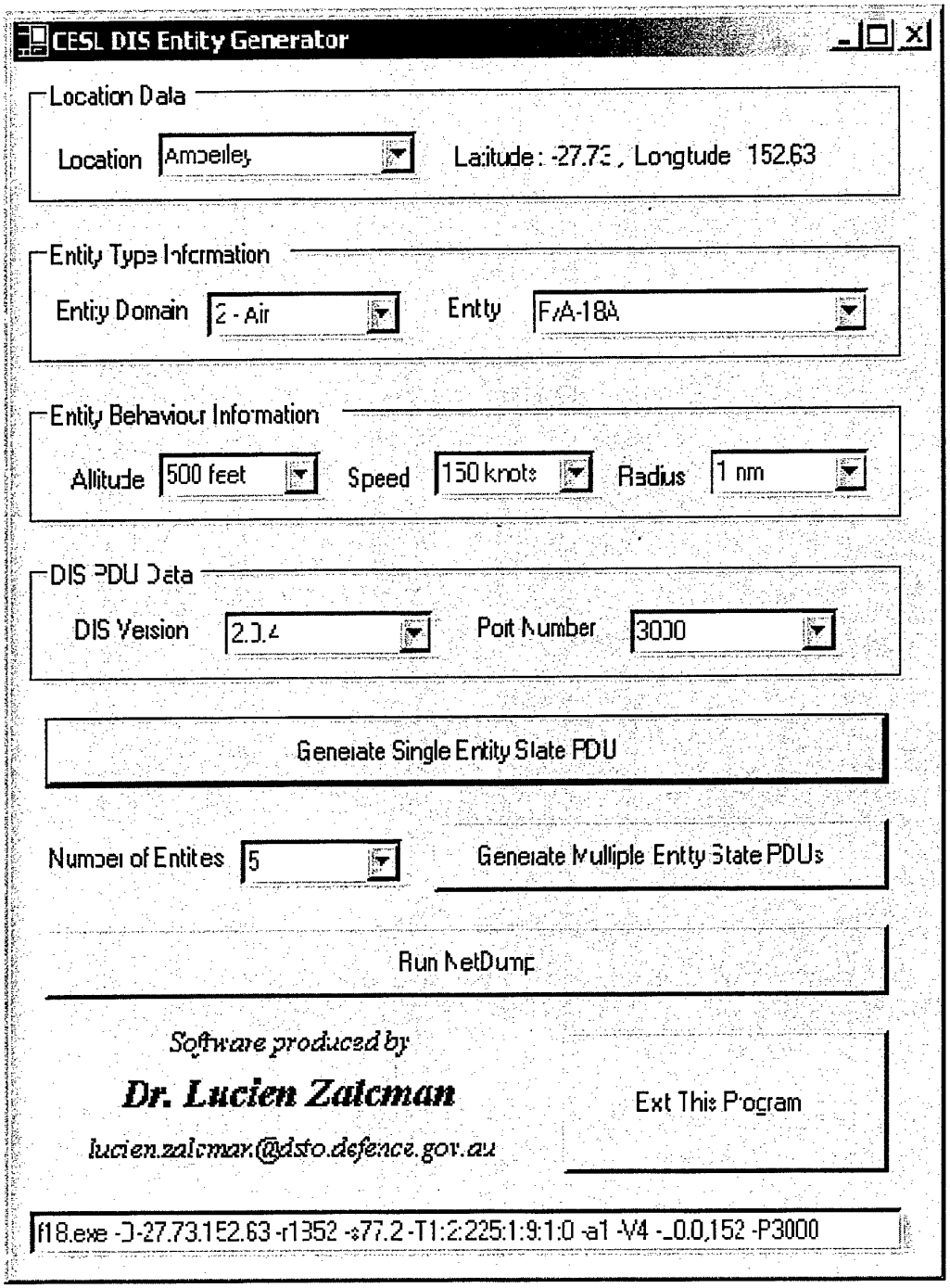

Figure 2: The ADSL DIS Entity State PDU Generator Application.

3.1 The Entity Configuration File

Previously the entities available from the Entity Generator were hard coded in the Visual Basic ADSL ManCon program. Although it was not difficult to add new entities and distribute the new version of the ManCon application to the ADSL computers, to continue this process if the Entity Generator was a CCT application would be impractical. In the set-up period before the I/ITSEC 2001 coalition exercise entity lists were distributed as Microsoft Excel spreadsheets using email. It was therefore decided to allow the CCT DIS Entity State PDU Generator to input important parameters using the concept of (simple text) configuration files. The entity configuration file (*entities.cfg*) containing entities similar to those used in the I/ITSEC 2001 exercise is shown in Figure 3.

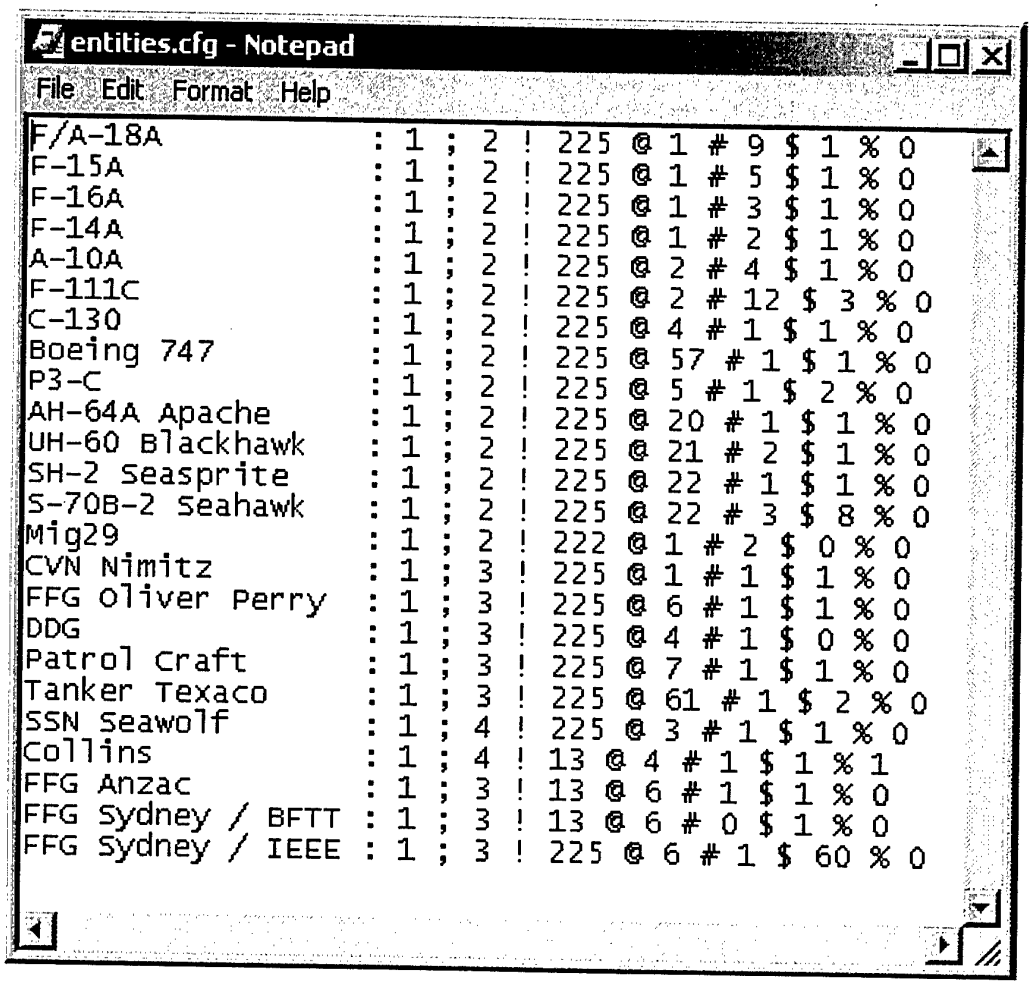

Figure 3: The Entity Configuration File.

When the CCT DIS Entity State PDU Generator application reads the entity configuration file it parses the input data text and separates the entities into their relevant domains as per the IEEE 1278.1A enumerations [7]. The domain is determined from the domain field in the entity enumeration data shown in Figure 3. The domains (eg. Air, Surface and Subsurface) found in the entity configuration file data shown in Figure 3 can be seen displayed in the Entity Domain listbox shown in Figure 2.

The Domain (eg. 2 - Air) and Entity Description (eg. F/A-18A) text is used to allow the selection of an entity in the CCT DIS Entity State PDU Generator. The IEEE Enumeration data text (eg. 1 ; 2 ! 225 @ 1 # 9 $ 1 % 0) is used to construct part of the command line parameters (-T1:2:225:1:9:1:0) when the MäK Technologies VR-Link Toolkit f18 application is called by pressing the "Generate Entity State PDU" button. This enumeration data can be seen as part of the f18 command line shown at the bottom of Figure 2.

Blank characters are trimmed from the textual data therefore allowing the configuration file to be formatted. However the exact delimiting characters, as shown in figure 3, must be used to separate out the various components of the entity data in the entity configuration file.

3.2 The Location Configuration File

The ADSL DIS Entity PDU Generator must be able to place the simulated entity's Entity State PDUs in any required geographical location. However the user of the application cannot enter latitude and/or longitude values as this is likely to be a more error prone way of entering the required location than simply selecting a location by name from a drop down listbox as is done in the ADSL DIS Entity PDU Generator.

Location information is input to the ADSL DIS Entity PDU Generator via a location configuration file (*location.cfg*) shown in Figure 4. Again, as for the Entity Configuration file, blank characters (which are removed) can be used to format text however the exact delimiting characters shown in Figure 4 must (again) be used to separate components.

Any text may be used to describe the geographical location. Figure 4 shows a "Hunter Liggett (Air)" location that, in the ADSL, is used to start circling aircraft above an airport in the widely used Hunter Ligget terrain database. The Hunter Liggett (Sea) location is used to start surface and subsurface entities in the sea in the Hunter Ligget terrain database. For the same reasons the location configuration file also contains "Darwin (Air)" and "Darwin (Sea)" location descriptions.

The latitude and longitude information obtained from the location configuration file is used to construct the position part (-O-27.73, 152.63 for Amberley) of the MäK Technologies VR-Link Toolkit f18 command line that can be seen at the bottom of the ADSL DIS Entity State PDU Generator menu shown in Figure 2.

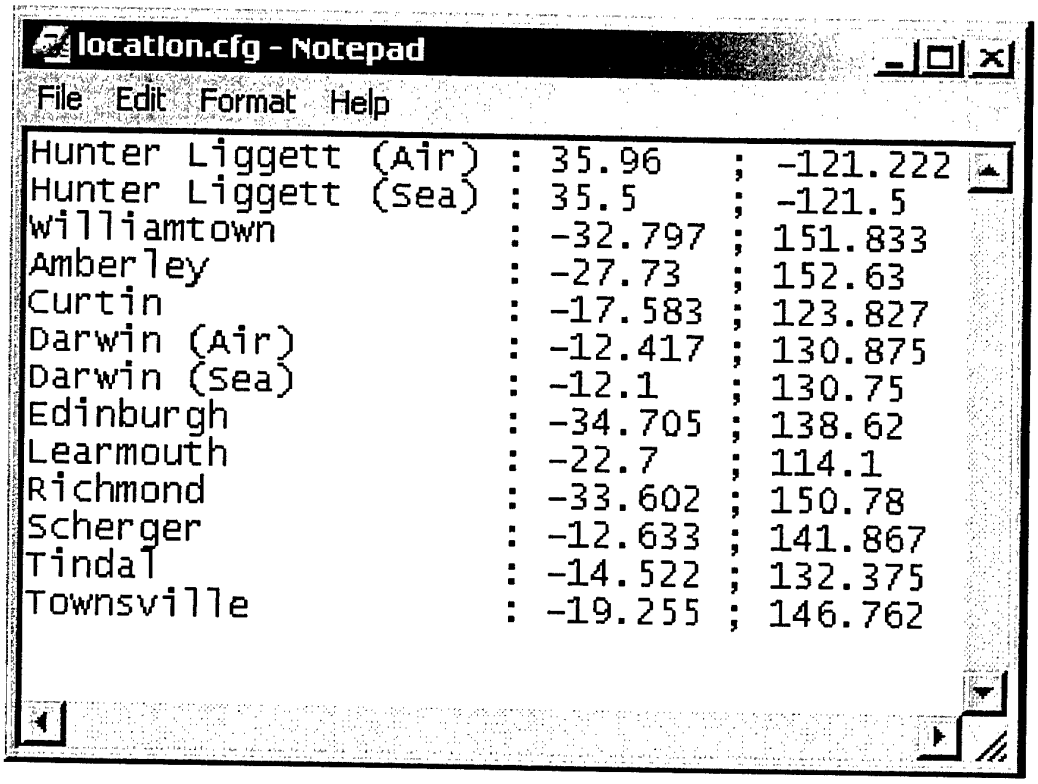

Figure 4: The Location Configuration File.

3.3 The Entity Behaviour Information

The Entity Behaviour information (altitude, speed and circle radius) are presented to the user in units which are most likely to be familiar to the user - feet, knots and nautical miles (nm). Although laboratory systems use mks units (altitude in metres, speed in metres/second and radius in metres) in a training exercise real equipment is likely to be in use and feet, knots and nautical miles are also most likely to be in use. Conversions from feet, knots and nm to their equivalent (DIS) mks units are designed to be approximate rather than exact to allow easy analysis of PDU data. These approximate conversions are shown in Table 1.

The Entity Behaviour components converted from the Altitude (500 feet -> 152 metres -> -L0,0,152), Speed (150 knots -> 77.2 metres/sec -> -s77.2) and Radius (1 nm -> 1852 metres -> -r1852) values as per table 1 can be seen in the f18 command line at the bottom of the ADSL DIS Entity State PDU Generator menu shown in Figure 2.

Table 1: Entity Behaviour Conversions.

Altitude		Speed		Radius	
Feet	metres	knots	metres / sec	nm	metres
Sea Level	0	5	2.6	1	1852
500	152	10	5.1	2.5	4630
1000	305	15	7.7	5	9260
2500	762	20	10.3	7.5	13890
5000	1524	25	12.9	10	18520
7500	2286	30	15.4	15	27780
10000	3048	150	77.2	20	37040
15000	4572	200	102.9	25	46300
20000	6096	250	128.6	30	55560
25000	7620	300	154.3	40	74080
30000	9144	350	180.1	50	92600
		400	205.8		
		450	231.5		
		500	257.2		
		600	308.7		
		700	360.1		
		800	411.6		
		900	463.0		
		1000	514.4		

3.4 The Port Number Configuration File

The de-facto port number used for DIS in the ADSL is 3000. However, for several reasons, other port numbers are often used. The ADSL DIS Entity Generator reads the available port numbers from the *port_number.cfg* configuration file shown in Figure 5. The relevant port number component (-P3000) in the f18 command line can be seen at the bottom of the ADSL DIS Entity State PDU Generator menu shown in Figure 2.

3.5 The DIS Version Number

The ADSL DIS Entity State PDU Generator produces PDUs supporting the following versions of DIS:

- DIS Version 4 - 2.0.4 [8];
- DIS Version 5 - 1278.1 [9]; and
- DIS Version 6 - 1278.1A [10].

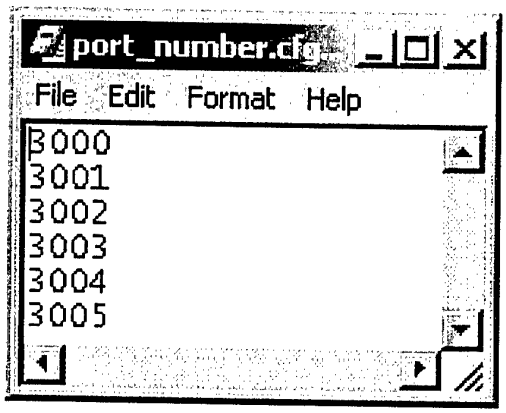

Figure 5: The Port Number Configuration File.

This data is hard coded into the ADSL DIS Entity State PDU Generator software and cannot be modified by the user. These versions of DIS should cover the vast majority of all simulators currently in use. The relevant DIS Version number component (-V4) can be seen in the f18 command line at the bottom of the ADSL DIS Entity State PDU Generator menu shown in Figure 2.

3.6 Generating Entity State PDUs

To generate an Entity State PDU the user need only press the "Generate Entity State PDU" button shown in Figure 2. The ADSL DIS Entity State PDU Generator then gathers the relevant selected data, constructs the f18 command line and then uses a "Shell" function to execute a copy of the f18 program using this constructed command line.

The Entity State PDU Generator maintains an Entity Number counter that is passed to the f18 program through the command line component (-a1) as can be seen in Figure 2. Each time the "Generate Entity State PDU" button is pressed, the Entity Number counter is incremented and passed to a newly launched copy of the f18 program through the command line.

This incremented Entity Number counter is then used as the Application Identifier in the Entity Identifier Record along with the Site Identifier (Site ID) and the Entity Identifier in the Entity State PDU. The Site Identifier is used to identify a particular simulation site, the Application Identifier is used to identify a particular application (simulation/simulator) at that particular site and the Entity Identifier is used to identify that particular entity in that particular simulation application at that particular site. Therefore each new instantiation of the f18 program is treated as a new DIS application (ie simulation/simulator) at a particular site on the DIS network.

This Entity State PDU Site : Application : Entity Identifier data triplet can be seen in the Netdump screen dump shown in Figure 6 on the right of the From: field identifier. The 1 : 1 : 1 data triplet indicates that this particular Entity State PDU was from the first entity generated.

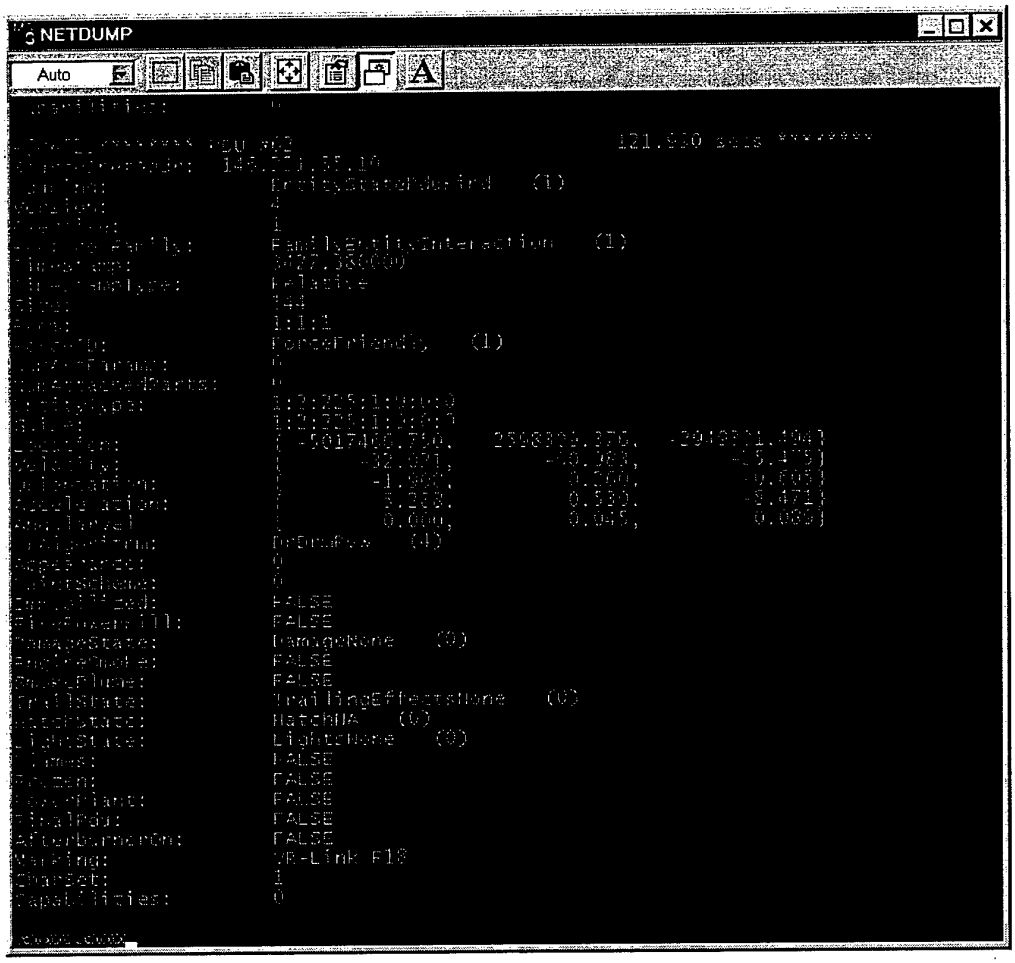

Figure 6: MäK Technologies VR-Link Netdump utility.

3.7 Generating Multiple Entity State PDUs

When testing an ADS simulator or network under load, PDUs from a large number of entities may be required. The ADSL DIS Entity Generator can generate Entity State PDUs in groups of 5, 10, 25, 50 and 100 entities. When generating Entity State PDUs in these groups of entities the Application Identifier parameter is automatically updated.

If Entity State PDUs from 200 entities are required the "Generate Multiple Entity State PDUs" button, with 100 entities chosen, need only be pressed twice. Therefore Entity State PDUs from many entities can be easily generated when required.

3.8 MäK Technologies NetDump Utility

The ADSL DIS Entity State PDU Generator uses the MäK Technologies VR-Link Toolkit f18 program to generate its Entity State PDUs. In addition to launching the f18 program the ADSL DIS Entity Generator can also launch the MäK Technologies VR-Link Toolkit Netdump application [6]. The Netdump utility, shown in Figure 6, is a DOS box application that displays the data found in DIS PDU fields. The latest version of Netdump appears (from personal observation) to support all DIS PDUs for (at least) DIS PDU Versions 4, 5 and 6.

Although the Netdump command line allows the application to be launched in an overlay view mode, Netdump is launched in its default scroll view mode from the ADSL DIS Entity State PDU Generator. Netdump is launched using the port number selected using the Entity State PDU Generator menu.

3.9 Exiting The ADSL DIS Entity State PDU Generator

There are two ways to exit / close the ADSL DIS Entity State PDU Generator.

Pressing the "Exit This Program" button on the ADSL DIS Entity State PDU Generator menu will exit the application. However before exiting, the application aborts all f18 and netdump processes and thus no Entity State PDU generating processes are left running. This option was not available in the Visual Basic Version 6 ADSL ManCon application. The user had to manually abort all the f18 and Netdump processes which could be extremely laborious when PDUs from several hundred entities are being produced.

If the user wishes to leave these processes running the application can be exited/closed by clicking the Window Close button (the button with an X at the upper-right corner of the window). Any running f18 and netdump processes will not be aborted and Entity State PDUs will continue to be produced and displayed.

4. Using The Common Coalition Toolset DIS Entity State PDU Generator

There are several ways that the ADSL DIS Entity State PDU Generator can be used during the set up and test phases of a coalition exercise / demonstration similar to that

held in conjunction with the 2001 I/ITSEC Conference. Some example uses are as follows:

- Executing the Netdump utility on the same PC running the ADSL DIS Entity State PDU Generator quickly allows the user to determine if Entity State PDUs are being produced on that PC;
- Executing the Netdump utility on another PC in the ADS network quickly allows the user to determine if Entity State PDUs are being correctly injected onto that ADS network;
- Out-The-Window simulators (eg piloted simulators) can test whether the correct model imagery is displayed for the various entities generated;
- Similarly 2D Display (eg a radar simulator) applications can test whether the correct symbology is displayed for the various entities generated; and
- Because the f18 application will position the selected entity at the exact virtual location specified in the relevant command line parameter (in the generated Entity State PDU), the Entity State PDU Generator can be used to test the correctness of the correlation between the entity displayed and its position in the terrain displayed. For example attaching the MäK Technologies PC Stealth product to a generated f18 Entity State PDU at the location specified by the location named as "Hunter Liggett (Air)" shown in figure 4 should result in an f18 model flying directly over an airport in the Hunter Liggett terrain database thus showing the correct positional correlation between the generated F/A-18 (DIS Entity State PDU) and the Hunter Liggett terrain.

In Distributed Simulation exercises similar to the I/ITSEC 2001 conference demonstration, the ADSL DIS Entity State PDU Generator has been found to be a convenient and powerful tool.

The ADSL DIS Entity State PDU Generator relies on the availability of the MäK Technologies VR-Link Toolkit f18 and Netdump utilities. Therefore the ADSL DIS Entity State PDU Generator user must have a legal copy of the VR-Link Toolkit.

The f18 utility could be replaced by producing an equivalent application using the (VR-Link Toolkit equivalent) US Navy developed SMOC Toolkit. This application should then be extended to allow the entity description, used to select the entity from the ADSL DIS Entity State PDU Generator menu, to be inserted into the Entity State PDU Marking Field via another f18 command line parameter. This is useful as this Entity State PDU Marking field is often used by COTS DIS applications to identify simulated entities.

The author is currently producing a Netdump superset application which can be distributed royalty free. This will be reported in a future DSTO Report.

If both the f18 and Netdump applications were replaced as proposed above, the three applications could be distributed royalty free as part of a Common Coalition Toolset.

Using the VR-Link F18 and Netdump utilities requires the purchase of the VR-Link Toolkit which may be considered as expensive by some coalition exercise participants.

Alternatively MäK Technologies may be convinced to sell the f18 and Netdump utilities separately.

In future because Microsoft's .NET architecture is network (eg internet) centric it may be possible to, yet again, rewrite the ADSL DIS Entity State PDU Generator as a WebForms application thus allowing the Generator to run as a Web server application on a remote computer placed on the other side of a Wide Area Network. Were this technology available for the I/ITSEC 2001 exercise it would have allowed exercise participants at the I/ITSEC 2001 Conference in Orlando, Florida to use an Internet Browser (eg Netscape or Internet Explorer) to connect to a World Wide Web server running on the other end of the Distributed Simulation Wide Area Network at HMAS Watson in Sydney, Australia to run the (now rewritten) Webforms application thus testing/stimulating all participating simulators over the whole (Local Area and Wide Area network components of the whole) Distributed Simulation network between Sydney and Orlando.

5. Summary and Conclusions

In summary, the main conclusions are:

- The entity generating components of the ADSL ManCon application have been rewritten using Microsoft's new Visual Basic.NET compiler. This new application is called the ADSL DIS Entity State PDU Generator.

- Microsoft's Visual Studio.NET (eg. including Visual Basic.NET) product is a complete redesign of the Microsoft programming languages' philosophy. Visual Basic.NET is now highly object orientated whereas Visual Basic Version 6 was not. All .NET compilers (including Visual Basic.NET) access operating system functionality through a common set of class libraries called the .NET Framework. Because all .NET compilers (C++.NET, C#.NET, Visual Basic.NET, etc) use the same .NET Framework class libraries (instead of libraries developed specifically for each individual language compiler) this should result in more reliable software applications.

- Deploying a Visual Basic 6 DIS application was difficult because use of Microsoft's Winsock ActiveX component required Service Packs up to and including Service Pack 6 to be installed. Often the only way to get the program to work properly was to install Visual Basic 6 Professional plus all the service packs on the same computer the application was to run on. Clearly this is not royalty free distribution.

- Deploying a Visual Basic.NET application is much easier. Any computer that was to run a .NET Framework application had to firstly install the .NET Framework Redistributable Runtime and the latest .NET Framework (cumulative) Service Pack. These free component downloads are available from Microsoft at

  http://msdn.microsoft.com/netframework/downloads/default.asp

  Once the .NET Framework Runtime (and cumulative Service Pack) was installed the ADSL DIS Entity State PDU Generator installed and executed flawlessly on any computer in the ADSL.

- If the ADSL DIS Entity State PDU Generator application is to be run from an application server, as in the ADSL, the .NET Framework security must be turned off on client computers. This is done by going to the .NET Framework directory on the client computer and running the following program:

  c:\winnt\Microsoft.NET\Framework\v1.0.3705\caspol –s off

- The ADSL DIS Entity State PDU Generator should be more reliable than the previous ADSL ManCon program, because the new Microsoft .NET Framework class libraries should be more "bug free" than the libraries used by the Microsoft Visual Basic version 6 since all .NET language compilers now access the functionality of the Windows operating system through the .NET Framework.

- It is proposed that the ADSL DIS Entity State PDU Generator be DSTO's first contribution to a Common Coalition Toolset of Advanced Distributed Simulation applications. These applications would be used to establish, maintain and analyse connectivity and interoperability for coalition training demonstrations and/or exercises. Having such a Common Coalition Toolset of applications, which all participating nations will have access to, allows such demonstrations and/or exercises to be more effectively and efficiently set up and maintained.

- Because of lessons learned from the I/ITSEC 2001 coalition exercise the ADSL DIS Entity State PDU Generator now reads entity enumerations, geographical location latitude and longitude data and port numbers through configuration files. This separates the deployment and maintenance aspects of the ADSL DIS Entity State PDU Generator from the usage aspects of the generator. Once the generator has been installed and is working, coalition exercise DIS data (eg DIS enumerations) can be easily distributed to participants by emailing updated configuration files.

- In future it may be possible to replace the MäK Technologies f18 and Netdump utilities and distribute the complete ADSL DIS Entity State PDU Generator capability royalty free to coalition exercise participants as part of a Common Coalition Toolset.

- Also in future a Webforms ADSL DIS Entity State PDU Generator may be able to remotely test the complete DIS network including the Wide Area Network components.

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Lucien Zalcman

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The recent I/ITSEC 2001 Coalition Training Demonstration held between the US, Australian and Dutch Navies demonstrated a coalition training exercise using Advanced Distributed Simulation to simultaneously connect military training simulators in the USA, Australia and the Netherlands. Whilst participating in the setup and running of this exercise each nation used whatever tools were available to establish and maintain connectivity and interoperability. As one of the lessons learned from such a coalition exercise, this paper discusses a proposal to make available to all participating coalition nations a Common Coalition Toolset (CCT) which comprises a set of software applications used to establish and maintain connectivity and interoperability for such coalition training demonstrations and/or exercises. This paper describes a candidate CCT application - a DIS Entity State PDU Generator. This application was found to be extremely useful when setting up a multiplayer Advanced Distributed Simulation such as the recent I/ITSEC 2001 Coalition Training Demonstration.